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TWENTY-SIXTH
ANNUAL REPORT
1952



CENTRAL STATES
FOREST EXPERIMENT STATION
Columbus 13, Ohio
PHILIP A. BRIEGLEB, DIRECTOR

CONTENTS

	<u>Page</u>
Introduction.	1
Forest Economics.	4
The Forest Survey.	5
Marketing Farm Woodland Products	6
Plans for 1953	6
Forest Management	8
New Experimental Forests	9
Management	10
Silviculture	11
Silvics.	13
Regeneration	14
Plans for 1953	16
Fire.	18
Danger Rating.	19
Fire Effects	19
Fuels.	20
Plans for 1953	20
Range	21
Control of Woody Plants.	21
Range Reseeding.	22
Plans for 1953	22
Forest Influences	23
Flood-Control Surveys.	23
Forest Influences Research	25
Plans for 1953	26
Forest Utilization Service.	27
Timber Harvesting.	28
Wood Seasoning	28
Other Activities	29
Plans for 1953	29
Personnel	30
Publications for 1952	32

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INTRODUCTION

In 1952 the Central States Forest Experiment Station completed its twenty-fifth year of operation. Compared with more than 150 years of forest exploitation, 25 years is not a long time. But it is long enough to give some perspective to the progress made and to the tasks ahead.

Fortunately the Forest Survey is now far enough along to give a fair idea of forest conditions throughout the Central States. After a century and a half of settlement and development, forests still cover more than 42 million acres. This is about one-fourth of the total land area; the original forest probably covered more than three-fourths. The rate of land clearing at present is believed less than the rate of reversion to forest; so several million acres may be added to our forest acreage in the foreseeable future. Lumber production in the Central States reached a peak of more than 4 billion board-feet per year about the turn of the century. The cut dropped to a low of half a billion during the depression year of 1932, but climbed again during recent years to about 1-1/2 billion board-feet annually.

Total growth of all timber now exceeds depletion by a good margin. But the higher quality timber so much in demand is being cut faster than it is growing. So timber quality is still deteriorating. The average net volume per acre is only one-half to one-fifth that believed necessary to produce the most and the best timber possible. In general, one out of every four trees of saw-timber size is too defective to be merchantable.

In spite of the present surplus of total timber growth over drain, this is a timber-importing region. Its people and industries use four times as much lumber as its sawmills produce. The central forest is producing only a small fraction of the wood the large central market consumes, especially in the higher grades and larger sizes.

Research and experience have yet to determine how much timber can be grown here, but the results beginning to accumulate from forest management research under way are encouraging. For example, during the year we found that net growth of upland hardwood forest was doubled by systematic harvest cutting and stand improvement

conducted as commercial scale operations on the Kaskaskia Experimental Forest. But a tremendous research job remains to be done.

Forest management research is under way in four of six major problem areas in the Central States. Work in one of these four was given added impetus during the year when a new experimental forest was established by cooperative lease agreement with the private owner. Still neglected are critical forest management problems in the Cumberland Plateau-eastern Kentucky area, and in the Knobs region of southern Indiana and adjacent Kentucky.

Much progress has been made in the field of wood utilization in the past quarter-century. Yet forest utilization studies made in central forests during recent years show that commonly little more than half the sound wood volume in the trees ever finds its way into wood products. The Station's Forest Utilization Service cooperated during the year with forest industry, the Forest Products Laboratory, and other institutions interested in wood research in trying to improve this situation. But the gain was small in comparison to the need. The Station's contribution to this effort suffered during the year when our Forest Utilization Section was reduced from a two-man to a one-man unit because of reduced funds.

Recognizing that good utilization and good forest management go hand in hand, Congress last year provided for a forest management-wood utilization pilot plant in the Carbondale problem area. This plant will be operated in cooperation with Southern Illinois University. At year's end the staff was being selected and work plans being made.

During the past 25 years the area of protected forest has been increased to more than 30 million acres. More than 10 million acres remain unprotected, however, and they are critically in need of protection. Much of the area now protected needs more intensive protection. Probably never before was there greater need for an efficient fire-control job. The one-man project in fire research sponsored by Region 9, the Missouri Division of Forestry, and this Station, is headquartered at the Northern Ozark Research Center. During the year a detailed analysis of regional fire-control problems was completed, and progress was made in developing a better fire-danger meter.

Record-breaking floods plagued the Central States during 1952 for the second consecutive year, dramatically demonstrating that our perennial watershed management problems are far from being solved. Misuse of our agricultural lands is frequently cited as a major flood cause. Flood-control studies made at this Station show that forest lands in poor condition are also important causes of damaging floods. These surveys show that most of the upland forest land in the watersheds examined is in poor hydrologic condition. Soils are

compacted and humus is depleted because of overgrazing, improper logging, or fire.

The flood-control survey program at the Station was discontinued near the end of the year for lack of funds. The Station is doing a modest amount of forest influences research. The work is aimed at developing forest-land management methods that will produce timber and at the same time maintain or establish favorable hydrologic conditions. This work must be accelerated and broadened if the forest soils and the waters that fall on them are to become more valuable sources of community and industrial wealth.

Importance of the range resource in the Missouri Ozarks was emphasized by the drought of mid-1952. Improved pastures using introduced species that have high yields in normal years suffered more than native grasses. As a result, range forage was increasingly in demand. Progress was made in developing efficient methods of releasing forage species from noxious plants. In addition, an over-all analysis of Ozark range problems was completed.

Scope of the Forest Survey project was broadened during the year. Reports were completed for several states in which field work was finished in previous years. Progress was made on the field work of the Forest Survey in Ohio. In addition, coordinated with the survey in Ohio, two new projects were started. First of these is an intensified cooperative survey of Wayne National Forest lands. The second is an experiment in forest survey techniques to make the survey cheaper and faster.

"Cooperation" was a key word in the 1952 research program. Much of the work in each division and at each center was done in cooperation with other groups, both public and private, that are interested in developing more efficient methods of managing forests and rangelands. Some details of this cooperative effort--progress, results, problems, and plans--are given on the following pages.

FOREST ECONOMICS

Research in forest economics began on a small scale at the Station in 1936. During and immediately following World War II, Station personnel contributed to the national defense effort by surveying lumber production and studying the production problems of essential timber products. A Division of Forest Economics was established at the Station in July 1946. The main activity of the Division has been to survey the forests of the Central States Region. The Forest Survey will provide the first reliable statistics on forest area and timber volume, growth, and drain for the six states in the region. Along with the Forest Survey, the Station has done some research in the economics of forest utilization and more recently in marketing the products of farm woodlands.

Early in 1952 work was completed on two special projects which had been continued from 1951. The Station's part in the nationwide survey of the manpower and equipment needs of forest products industries was completed and the reports prepared. Reports were also completed for the photo interpretation phase of the Survey of Land Use and Forest Conditions in the Ryukyu Islands. Moessner helped prepare a paper about this survey to be presented at the Asia Forestry Congress in Singapore.

Moessner was a delegate to the VII International Congress of Photogrammetry held during September in Washington, D. C. As a member of the panel on photo interpretation he presented a paper, "Photo Interpretation in Forest Inventories," which will be published early next year in Photogrammetric Engineering.

During 1952 the photo interpretation section continued its research in the use of aerial photography in forest inventories. Following the analysis of a pilot study of aerial photo survey methods in western Ohio made in 1951, a project of Forest Survey techniques research was begun in southern Ohio. The main purpose of this study is to test new forest inventory methods that rely more on photo interpretation and less on field work.

In cooperation with the Wayne National Forest, the Forest Survey is making an estimate of the national-forest timber volume. The data collected will be used both for inventory and to test the value of aerial cruising in making timber management plans.

All field work for these projects has been done by a single two-man crew, one man from the Wayne National Forest helping out at irregular intervals. So progress of the Forest Survey in Ohio has been retarded.

In cooperation with the Carbondale Research Center, procedures were developed for recording and analyzing forest management study data by means of IBM punched cards. When the system is perfected it may be used by other research centers. The aim is to develop in Columbus a records and analysis service that may be used for any job that punched-card methods are suitable for.

Because Forest Survey funds were further reduced beginning July 1952, a reduction in personnel was imminent. However, the problem solved itself when Winters and Becker were chosen for 2-year assignments in Pakistan. Winters will serve as an advisor on forest research to the Government of Pakistan and Becker will be his assistant. This assignment is part of the Point IV program giving technical assistance to underdeveloped countries.

THE FOREST SURVEY

Since the Forest Survey began in July 1946, field work has been completed in Missouri, Illinois, Kentucky, and Indiana. About 70 percent of the field job in Ohio is done. Remaining to be covered are the rest of Ohio, Iowa, and the forested eastern portions of Kansas and Nebraska. Considering all phases of the work, the initial Forest Survey of this Station's territory is about 80 percent completed.

Two comprehensive forest resource reports have been published so far--one for Missouri (in 1950) and one for Illinois (in 1952). During 1952 a preliminary report for the State of Kentucky was published. This report contains the forest statistics for the State and a minimum of discussion and interpretation. It shows that Kentucky's forests, covering 45 percent of the total land area, are generally understocked and of poor quality but have a high potential.

A report, "Forest Statistics of Central and Northern Indiana," was published by the Station in December. The statistical report for the entire State was completed at the end of the year and is scheduled for publication in January 1953. This report shows that Indiana has more than 4 million acres of forest land. Most of the timber growing on this land is poor quality, but the opportunities for improvement through management are impressive.

Several articles pertaining to survey techniques and results were prepared and published in such periodicals as the Journal of Forestry, the Southern Lumberman, and Outdoor Indiana.

MARKETING FARM WOODLAND PRODUCTS

Farm woodland marketing research at the Station is carried on under authority of the Research and Marketing Act of 1946. New and better markets for farm woodland products are being sought.

During 1952, a study to encourage new markets for pine timber in the Missouri Ozarks was completed. The report, "Pine Resources and Markets in the Missouri Ozarks," published by the Missouri Division of Resources and Development, indicates that Missouri Ozark pine timber should be able to support a new and expanding post or pulp industry. Shortleaf pine is an important timber tree on about 3 million acres in the Missouri Ozarks. Not much pine is now of sawtimber size, but growth is rapid and in 10 years, if good management is practiced, the present annual harvest can very likely be increased by 50 percent. At that time, the pine timber available for cutting should be about 175,000 cords annually. The well-stocked young stands of pine and pine-oak timber need light thinning cuts. A post or pulpwood market would provide an outlet for these small trees.

A study was begun in southern Ohio to determine the financial returns from timber sales in which a farm forester helps the farmer to market his timber. The latest Census of Agriculture reported that the average annual income from farm forests in Ohio was only \$0.82 per acre. In contrast, on the first farm timber sale studied, the well-managed farm forest was earning about \$5.00 per acre per year. This study shows that farm-forest owners can expect increased returns if they manage their timberlands to promote good growth, and sell their timber as carefully as they do other farm crops.

PLANS FOR 1953

The analytical report, "Kentucky's Forest Resources and Industries," will be completed and presented for publication. A similar report for Indiana will be completed and submitted for final review during 1953.

Photo interpretation, field work, and computations for Ohio are scheduled for completion by the end of the year. A report giving forest area and timber-volume statistics for northern and western Ohio will be published. The Forest Survey of the Wayne National Forest will be completed and a tabular report prepared. Survey techniques used in southern Ohio will be analyzed and a report prepared for publication. The forest inventory methods for Iowa will be based on the results of this study. Field work in Iowa will probably begin late in the year.

The Economics Division is responsible for collecting and compiling inventory, growth, and drain data for the Timber Resources Review of the Central Region.

The studies of farm-timber sales in Ohio will be continued. One or more articles illustrating the returns these farmers are getting as a result of good timber marketing will be submitted for publication in a regional farm magazine. In addition the size of the potential market for wood chips to be used as animal bedding, poultry litter, and soil mulch will be investigated.

FOREST MANAGEMENT

The major forest problems of the Central Region fall into two general groups: (1) Rehabilitation or improvement of the present forests, and (2) regeneration of forests on lands now without cover. Also important, of course, are other problems of forest management--particularly silvicultural problems--that must be solved in order to get the most and the best timber possible from the better stands. Finally there is the question of marketing; difficulty in finding the proper markets for their timber products has discouraged many woodland owners from practicing good forestry. The following pages will tell you briefly what we are doing and what we plan to do in the Division of Forest Management Research to help in solving these problems. But before getting into the details of our research work, there are several items of general interest that should be mentioned.

First is the subject of cooperative research. Pooling of funds by the Station and other groups makes possible certain projects that otherwise could not be undertaken. In 1952 all research centers were engaged in such work. The total cash contributions by other agencies amounted to \$65,000. In addition, about 3,000 acres of private land are under lease or agreement for various kinds of management research. And at the end of the year negotiations were under way to extend this cooperation.

Second is the problem of getting research results put into practice. This is an important part of the forest researcher's job. The printed word, of course, is one way to disseminate ideas. Station publications, trade journals, farm journals, and newspapers all help get technical information to the people who can use it. But a quicker, more effective way apparently is to show people the results on the ground. The old saw "seeing is believing" certainly holds true for research results. Approximately 400 persons--both foresters and laymen--visited the experimental forests during the past year.

The most notable research results now in practice have to do with regeneration (especially on lands stripped for coal), farm forestry, and encouraging and controlling natural regeneration.

Third is the ever-increasing problem of utilizing low-grade wood. In order to improve a forest stand economically, the owner must be able to dispose of the material he removes and at least break even. In 1952 Congress provided \$35,000 to begin research in this very practical and important field. This work will be done at the Carbondale Research Center in Illinois.

The long-view objective is two-fold: (1) To make good forest management attractive to the owners of low-grade stands, and (2) to improve the general forest economy. However, the immediate aims are to increase the local demand for low-quality wood and to lower the logging and manufacturing costs.

This project is being developed in cooperation with Southern Illinois University. The processing plant (to be housed by the university) will also serve as a training ground for students interested in the wood-using industry.

NEW EXPERIMENTAL FORESTS

Vinton Furnace

A 1200-acre tract located near McArthur in Vinton County, Ohio, and to be known as the Vinton Furnace Experimental Forest, was leased from the Baker Wood Preserving Company in 1952. Physiographically, the tract is considered typical of at least half of the unglaciated region of southeastern Ohio. Almost completely forested, it is perhaps representative of even a greater proportion of the stand types and conditions in this problem area. The oak-hickory type, with its variations, predominates; the most important species are white, scarlet, chestnut, black, and red oak, hickories, and yellow-poplar. Many other species are common. Stand ages vary from 30 to more than 100 years. Both good and poor sites occur on the tract, thus affording a cross section of conditions for forest management and forest influences research.

During the summer and fall of 1952 a road into the tract was improved and a building was erected to house equipment. Also, approximately 5 miles of former woods roads were improved or new ones constructed so that all parts of the tract are accessible in dry weather. A series of permanent plots was located and measured on the forest. These plots will be used to inventory the tract and to measure future changes.

Knotwell

A 3000-acre area near Newburg, Phelps County, Missouri, and within the Rolla Ranger District, Mark Twain National Forest, has been selected for an experimental forest representing the blackjack-post oak or dry-site oak type. The necessary descriptive data have been collected and a rough draft of a report has been prepared recommending that the area be formally set up as the Knotwell Experimental Forest.

MANAGEMENT

Many of the management experiments have been begun only recently and some of the most important results from these will be forthcoming years in the future. However, much useful information has already been obtained.

For example, in a demonstration area in southern Illinois intended to compare the results of good and fair forest practices, it was shown that an all-aged upland hardwood stand will respond readily to improvement and release cuttings. In the "good" practice stand all merchantable trees not wanted as growing stock were cut, leaving only thrifty, well-formed poles and sawtimber. All cull trees were killed. In the "fair" practice stand all merchantable sawtimber was cut, except 15 of the best small- and medium-sized trees per acre. No pole-sized trees were cut and no culls were killed.

After 4 years the "good" practice stand had grown 334 board-feet (International 1/4-inch scale) per acre per year. The "fair" practice stand had grown 318 feet per acre per year. Unmanaged stands on similar sites are growing less than half this fast.

Another project in Illinois, begun late in 1952, shows the quality of material found in various hardwood species. Although the purpose of the study is to compare various degrees of cutting in bottom-land hardwoods, the logs taken out in the original cut were graded. The Forest Products Laboratory log grades were used. Half or more of the material cut from sycamore, sweetgum, and red oak trees made grade 1 logs. Slightly more than one-third of the silver maple and white oak was grade 1. The poorest species were pin oak, cottonwood, elm, and ash. Less than one-fourth of the material from these species was in grade 1 logs. However, a previous cut had taken much of the better ash so most of the ash trees removed in this study were small.

In order to find out if parts of trees wasted in logging could be removed from the woods economically, all such material was cut into fuelwood following a salvage cut in Iowa. The wood was sold at a net loss of \$1.45 per cord. Indications are that to make such an operation pay for itself, more efficient logging methods must be used, and better markets must be found. Possibilities of increasing efficiency are rated good and will be explored in future tests.

Still another possibility for using poor-quality and waste woods material was demonstrated on four different occasions in Iowa. The idea is to use wood chips instead of straw, which is becoming increasingly scarce, for livestock bedding. The demonstrations show that the small portable wood chipper used is not well adapted for large-quantity production. Bigger equipment is needed.

Comprehensive upland hardwood management studies are being conducted on 36 compartments of about 20 acres each on the Kaskaskia Experimental Forest in southern Illinois. These studies compare two rotations, two cutting cycles, intensive and extensive cultural treatments, and even- and uneven-aged management applied in various combinations on two forest types.

Also on the Kaskaskia Experimental Forest, a demonstration of forest management on good and poor forest is being conducted. The "good" demonstration area contained better-than-average stocking, diameter distribution, and growth, permitting a light annual harvest. In contrast, the "poor" forest had been over-cut, grazed, and burned repeatedly, and would not sustain an annual cut. On both tracts the harvest cut was accompanied by intensive improvement treatment. Although this experiment is only 4 years old, it has already shown that a thorough harvest-improvement cut for rehabilitation can pay for itself.

Other management studies being carried on during 1952 include the following:

1. A test of "reasonable" forest practices as set up by the Forest Service, in cooperation with other forestry groups.
2. Thinning, pruning, and stocking in shortleaf pine plantations.
3. Optimum cutting cycle for upland mixed oak:

SILVICULTURE

Most research in silviculture being done at the Central States Station may be divided into three general classes for convenience: (1) Thinning, (2) pruning, and (3) sprout control. Results of work in each of these classes will be discussed separately.

Thinning

After 4 years, a young stand of pure pin-oak in Illinois showed faster growth and less mortality on heavily thinned plots than on lightly thinned plots. In fact, plots that were thinned to 65 square feet basal area made 2-1/2 times as much volume growth as plots given merely a light salvage cut. Total cubic-foot volume is now about the same for all plots.

Thinning a 13-year-old loblolly pine plantation gave less striking but similar results. After 4 years, growth was the same for both the thinned and the unthinned plots. However, growth on the thinned plots was put onto the fewer, better trees that were left, but growth on the unthinned plots was dispersed on all trees, good and bad alike. Moreover, the crowns on the trees on the

thinned plots are now more fully developed, promising even better growth in the future.

Another thinning experiment, in a 50-year-old white pine plantation in Iowa, has not yet shown any positive response to release after 4 years. Lack of response to thinning may be attributed to the slow development after release of the small crowns of trees in the original stagnated stand. More favorable results may be shown in a few more years.

Pruning

A walnut pruning study, begun 2 years ago in Kansas in cooperation with the American Walnut Manufacturers Association and the Kansas Forestry, Fish, and Game Commission, is beginning to show some results. In general, the pruned trees (especially those that had from one-fourth to one-half the crown removed) are now growing faster in diameter than the unpruned ones. More severe pruning seemed to encourage height growth but not diameter growth, especially on the larger (4- and 5-inch diameter) trees. One difficulty encountered was the sprouting of pruning-wounds or healed-over branches. Such sprouting was greatest on the more heavily pruned trees.

A similar pruning study on jack pine in Iowa showed a reduction in both height and diameter growth in all plots, including the unpruned plots. Apparently competition for soil moisture and nutrients has become critical throughout the entire stand. So the pruning itself cannot be said to have been harmful. Indications are that 50 to 60 percent of the crown length of jack pine can be removed without significantly retarding growth.

Sprout Control

A study in Missouri to find out how different methods and seasons of girdling blackjack oak affect later sprout development was completed in 1952. Trees girdled by peeling had smaller and fewer sprouts than those girdled by notching. Moreover, sprout mortality was higher in the peeled trees than in the notched ones.

The growing season appears to be the best time to girdle blackjack oak. Sprouting was greater in trees treated during the dormant period than in trees treated during May, June, and July. A complete report on this study will be published in 1953.

Thinning oak stands may result in epicormic branching. A study of 25- and 50-year-old oak stands in Iowa indicates that in a heavily thinned stand the residual trees produce more and faster growing epicormic branches than in a lightly thinned stand. The dilemma is of course that to discourage epicormic branching by

thinning more lightly means a sacrifice in growth rate of the selected crop trees.

Other Studies

In 1948 a study was begun to find out if coppicing black walnut and red oak would produce better formed trees than the seedling trees growing in CCC plantations. Conclusions are that too many of the sprouts died and that growth on those that survived was too slow to make the treatment worthwhile. Furthermore, the form of the sprouts was little or no better than that of the original stems.

An experimental release cutting was made in a bottom-land hardwoods stand on the Brayton Memorial Forest in Iowa. This stand had been cut 8 years before; only defective trees and nonsalable species were left. In 1952 this stand was cut to release the reproduction. The material was sold at a profit to a nearby box and crate plant, thereby demonstrating that if good markets are available, forestry will pay for itself at nearly every turn.

Other silvicultural studies in progress or begun in 1952 are intended to answer such questions as these:

1. How can reproduction in upland mixed oak forests be established?
2. Which upland oak trees should be released?
3. What is the best way to thin shortleaf pine?
4. Will black locust - yellow-poplar plantations respond to release?
5. What is the best stocking for even-aged oak-hickory stands?
6. Does disking help pine germination and stocking?

SILVICS

A project to find out if and to what extent the chemical composition of a tree's foliage reflects the amount of available elements in the soil as well as other site characteristics is showing results. For example, it has been determined that the amount of calcium in white oak leaves varies with the amount of silt and clay and the concentration of roots in the A horizon. But this is just one of the many relationships studied. Complete details of this work will soon be published.

A study in Ohio indicates that about 10 percent of the abandoned farmland can be expected to reforest naturally. The smaller old fields (less than 5 acres) in the lee of and adjacent to seed sources of desirable species have the best chance of reseeding without man's help.

REGENERATION

Reforesting strip-mined land is a perennial problem in the southern part of the Central Region. The Experiment Station has been helping solve various phases of this problem. Some of the recent findings are mentioned below.

Natural regeneration of trees on stripped lands is apt to result in sparse stands of poorly formed trees unless there is an adequate seed source nearby. However, most strip-mined lands are not located near enough good seed sources to restock naturally; they must be planted.

In general, species native to the area are best for planting purposes; introduced species do not do as well. Natural reproduction in strip-mine plantations is usually sparse and made up of less desirable hardwoods. However, mixed hardwood-pine plantations contained more desirable species and larger trees than pure pine plantations. In pure walnut plantations, natural reproduction was very scarce, probably because of the toxic condition associated with this species.

The oxidation of sulfur compounds to sulfuric acid in recently exposed soil causes acidity on much strip-mined land. A simplified field method for estimating the sulfur content of these soils was developed in 1951 in cooperation with Southern Illinois University. The method permits quick, accurate predictions of future bank acidity on freshly strip-mined areas. "Soil" from banks on strip-mined land was analyzed in the laboratory and the acid content coincided very closely with the predictions made in the field. This will be a great aid in future planting programs on stripped lands.

Studies in pine plantations revealed that white pine grows higher in pure stands during the first 20 years than in mixed stands. However, after 20 years, height growth is faster in mixed stands. Diameter growth of white pine is about the same for both pure and mixed stands. Red pine, on the other hand, grows faster both in height and diameter in mixed plantings. Site quality for both pines is best where the A horizon is thickest and the silt and clay content the least.

Experimental plantings have shown black locust to be successful as a nurse crop for many hardwoods in the Central Region. Further studies are now in progress to determine how much black locust to plant, when to plant, and the best spacing.

Seven species of conifers and hardwoods were planted in 1947 on poor and average upland old-field sites in southern Illinois. Preliminary results were published early in 1952 (Station Note No. 67). All of the conifers planted (including loblolly, shortleaf,

and white pine, and eastern redcedar) showed promise of making successful plantations. The hardwoods had satisfactory survival, but made very poor growth.

In planting yellow-poplar, it was found that for best results the seedlings should have a stem diameter at ground line of at least $2/10$ of an inch. If roots are to be pruned to eight inches or less, diameters of about $4/10$ of an inch are in order. Pruning the tops to about 5 inches does not adversely affect survival and growth, and it does make packing, shipping, and planting cheaper.

If good hardwood growing stock is lacking in a poor oak-hickory stand, a promising way to convert the stand is to clear cut and plant pine immediately. If some good oak and hickory remains, the stand can be converted gradually by cutting holes in the canopy at least $1-1/2$ times as broad as the height of the tallest trees.

A study to compare how various methods of planting affect survival and growth of hardwood seedlings was reported on this year. Size of scalp and whether or not roots were pruned and scalps mulched made little or no difference in the survival of the seedlings. However, best growth occurred on the larger, mulched scalps.

Other regeneration experiments in progress include:

1. A study of the effects of a synthetic polyelectrolyte resin (Krilium) on plantation development and bank stabilization.
2. The problem of direct seeding of pine. Experiments so far have shown this method of reforestation to give erratic and therefore undependable results; it is not generally recommended.
3. Success of about 35 different coniferous species in plantings in Iowa.
4. An experimental planting to find out if any of several strains of Chinese chestnut are suitable for some of the better Ozark sites.
5. A test of shortleaf pine, jack pine, and yellow-poplar seeds from various sources throughout the country to see how much the origin of the seed affects survival and growth of the seedlings.

PLANS FOR 1953

The Ames Research Center (Iowa)

Will continue work on...

1. The jack pine pruning study.
2. Cutting cycles for farm forests.
3. A black walnut growth and yield manuscript.
4. Influence of soil reaction and organic matter in tree vigor and growth (in cooperation with the Department of Forestry, Iowa State College).

Will begin work on...

1. A reproduction study in bottom-land hardwoods.
2. Plans for a proposed planting-methods study.

Will report on...

1. Stand density as it affects epicormic branching in oak.
2. Walnut and oak coppicing.
3. Yield of products from low-grade logs.
4. Lumber grade yields from logs of different grades.
5. Results of planting about 35 different coniferous species.

The Buckeye Research Center (Ohio)

Will continue work on...

1. Reclamation of strip-mined land.
2. The use of a polyelectrolyte resin (Krilium) as a soil conditioner for forest trees.
3. Yellow-poplar planting stock-grade study.
4. Yellow-poplar progeny tests.
5. Foliar analysis studies.
6. Forest influences studies.

Will begin work on...

1. Forest management studies on the new Vinton Furnace Experimental Forest.
2. A general management plan for this forest.
3. A complete survey of this forest.

Will report on...

1. The analysis of yellow-poplar foliage.
2. The relation of foliar analyses to site characteristics for white oak.
3. The growth of planted red and white pines in relation to the soil and topography of unglaciated old fields.
4. A stocking guide for white oak.
5. A comparison of planting techniques for reforesting old fields.
6. A site index meter for white oak in southeastern Ohio.

The Carbondale Research Center (Illinois)

Will continue work on...

1. Improving the new forest utilization pilot plant (in cooperation with Southern Illinois University).
2. The upland hardwood management study.
3. Use of the punched-card summary system for more readily analyzing data.
4. Marking, cutting, and pruning pine plantations.
5. Thinning loblolly pine.
6. Pin-oak stocking study (in cooperation with the Shawnee National Forest).
7. Management of older plantations.

Will begin work on...

1. Plans for the upland hardwoods optimum stocking study.
2. New studies on strip-mine planting.
3. A reproduction study in bottom-land hardwoods.

Will report on...

1. Management of "good" and "poor" farm forests.
2. First 4-years' growth of loblolly pine plantations.
3. Interim stocking guides for upland hardwoods.
4. Growth of a cottonwood stand after thinning.
5. Sulfides in the soil on strip-mined land.
6. Converting poor oak-hickory stands to shortleaf pine-hardwoods.
7. Reforestation and the economy of southern Illinois.

The Northern Ozark Research Center (Missouri)

Will continue work on...

1. Shortleaf pine thinning studies.
2. Black walnut pruning study.
3. Chinese chestnut experimental plantings.

Will begin work on...

1. Field work for the shortleaf pine seed source study.
2. The influence of soil on the management of second-growth shortleaf pine.

Will report on...

1. Shortleaf pine thinning studies.
2. Sprouting of blackjack oak.
3. Converting low-grade hardwoods stands to pine-oak.
4. Direct seeding of shortleaf pine to improve stocking.
5. Survival and growth of plantings on strip-mined land.
6. Black walnut pruning.

FIRE

The summer and fall of 1952 will be remembered in the Central States for the droughts and the many severe forest fires. The spring fire season passed without great loss. But in late May the first drought and heat wave began and were not broken till mid-July. The normal decrease in fire occurrence after May did not occur this year. There were many more fires than usual in June and July, but the green vegetation and light winds helped keep the fire situation from getting out of hand.

A second drought began in September and continued with only slight relief until November 9. The days were warm, dry, and windy. On several days the air was heavy with smoke and visibility from lookout towers was less than 2 miles. All this added up to the worst fire danger in years, paralleling similar situations in the past which resulted in catastrophic fires.

Some fires this fall grew large because they escaped early detection; some because the numerous back-fires, set to protect homes and buildings, burned together with the main fire; and still others because they were too hot to handle at strategic times or places. Some of the most difficult fires to control occurred just as the leaves were falling. The rapid fall of leaves covered the newly burned areas, blanketing control lines and permitting reburns in a matter of hours. In places fires crowned through the dry oak leaves and the heat started many dangerous whirlwinds. The heat was much greater than usual because the fuel was so dry and so much of it burned at once.

The damage to forest growing stock was severe. Buildings, crops, and improvements were also damaged. At least one fire fighter was severely burned.

In Missouri most people realized the danger of fire and gave almost unanimous approval to restrictions imposed by the Regional Forester and the Governor. For the first time the Governor of Missouri proclaimed an emergency, suspending hunting and fishing, and restricting camping and picnicking. Restrictions were also imposed by the States of Ohio, Indiana, and Illinois. National forests in these states were closed to smoking and camp fires. Because of these precautions the peak of fire occurrence passed before the end of the drought.

These fires present a challenge to the Fire Research Unit recently established at the Northern Ozark Research Center. How can research help anticipate and prepare for such situations and otherwise get a better job of fire control done?

DANGER RATING

The purpose of fire-danger meters is to estimate the current fire danger so that adequate but not wasteful preparations can be made to meet it. In the Central States, fire-danger estimates are based upon the "Central States Danger Meter." However, such a meter has other uses. A reliable meter can be used to help interpret fire prevention and suppression accomplishments and can serve as a control in several types of research studies. So an analysis of fire records in relation to the Central States meter ratings was given a high priority in this year's work program.

The 1946-51 fire records of the Clark and Mark Twain National Forests of Missouri were used in the studies begun this year to (1) Test the effectiveness of the Central States Danger Meter, (2) evaluate the ratings of the meter, by districts, in terms of fire occurrence and behavior probabilities, and (3) suggest new uses for the meter.

As expected, the frequency of fires appears to vary directly with maximum daily meter ratings. However, departures from this correlation may help point out weaknesses which need to be corrected.

If a significant relationship does exist between fire occurrence and meter ratings, it will then be possible to estimate the number of fires that could be expected for a given rating or a total of daily ratings for a month or season. This number compared with the actual number of fires would help measure the effectiveness of fire-prevention activities.

There also seems to be a correlation between areas burned and meter rating: An increase in meter rating was accompanied by a marked increase in area burned.

An article, "The Role of Burning Index in Fire Danger Estimation," was submitted for publication in Fire Control Notes.

FIRE EFFECTS

The effects of burning the forests are not easily measured nor in many cases are they fully appreciated by the local people. This year a start was made on the job of finding out just how fire affects various tree species and how to predict mortality and future value of burned trees.

FUELS

Litter and grass are the most prevalent forest fuels. They are present in various amounts because of past burning, composition and density of stands, exposure, and season. Questions still to be answered about these fuels are: What is the annual rate of accumulation and decomposition of forest litter? Does mass of litter and grass affect the damage that fire may do to trees, the forest floor and soil? Do litter and grass make it harder to control fires? Do they affect the behavior of fires, and the moisture relationships in the litter and soil?

Studies were begun this year to develop a better understanding of fuels and their affect on fire control. One of these studies is being carried out in conjunction with a pine stocking study at the Sinkin Experimental Forest. The purpose of this study is to determine the changes in fuel that take place with different degrees of cutting in pine stands.

PLANS FOR 1953

Compare fire occurrence and behavior with the Central States Danger Meter ratings for the Missouri national forests.

Begin studies to determine whether cumulative daily maximum meter ratings can be used in the Central States as an index of drought. Determine the value of the cumulative ratings for indicating forest closures and the strength of presuppression organization required.

Evaluate the effect of the 1952 forest closures on fire occurrence.

Determine the effect of controlled range fire on redcedar.

Begin studies on the role of grass and litter in fire behavior and control.

RANGE

A popular opinion among technical foresters, agriculturists, and some farmers is that Ozark range forage is so unpalatable and so low in nutritive value that it is not worth harvesting. An associated idea is that if cattle are to be raised on grass in the Ozarks, they should be raised not on range but on improved pasture. The summer of 1952 was too dry for many tame pasture grasses to thrive but not too dry for such native forage grasses as big and little bluestems, Indian grass, purple top, switchgrass, and broom-sedge. All of these native species continued to grow during the dry weather and were closely grazed during the period when orchard grass and other tame grasses were essentially dormant because of drought. Also, range cattle appeared to do about as well in 1952 as in wetter seasons when they made little use of the native perennial grasses.

Obviously, the native range forage was neither unpalatable nor seriously deficient in nutrients in 1952. Certainly the heavier utilization of native forage and the larger number of applications for permits to graze cattle on national-forest land indicate that Ozark ranges provide valuable forage.

Not only do cattle need range forage when tilled forage is inadequate, but the people need livestock income when the timber income fails or is reduced. It is true that standing timber will keep until the market picks up, but trees in the woods won't pay the grocery bill. Families that have a few livestock are better able to weather a period of unemployment than are families whose incomes are derived entirely from work in the woods.

The range problem analysis was completed for review in 1952. Arrangements were made with the Botany Department of the University of Missouri for a cooperative project to evaluate and describe the important range plants of the Missouri Ozarks. A rough-draft manuscript on the effects of overhead release on herbaceous vegetation in forest stands was prepared in cooperation with the Missouri Wildlife Research Unit and the Missouri Conservation Commission.

CONTROL OF WOODY PLANTS

Study of woody plant control was the main work in range research in 1952. A 300-acre controlled burn on the Mark Twain National Forest provided an opportunity for an informal study on the control of eastern redcedar by broadcast burning. Apparently trees up to 6 feet high can be killed by grass fire if there is enough fuel. Tentative results of one study on the use of 2,4-D and 2,4,5-T as basal bark treatments on sassafras and persimmon have been published in Technical Paper No. 132. In addition, various poisons and methods of application are being tested on oak reproduction and saplings.

RANGE RESEEDING

The 1952 summer drought was a critical test for grass seedings in southern Missouri. In some localities precipitation was markedly below normal for every month of the growing season. In others, a period of above-normal rainfall occurred in midsummer.

The July-August break in drought conditions around Licking, Missouri, was a lifesaver for orchard grass, one of the most reliable tame-pasture species for southern Missouri. Even though grazing use was heavy during 1952, recently established orchard-grass stands that were moderately grazed in 1950 and 1951 had a higher basal density in mid-October 1952 than when previously checked in April 1951. In contrast, in areas where the precipitation in midsummer was not great enough to break the drought and where past grazing use has been heavier, orchard-grass stands lost from one-third to nine-tenths their basal density between April 1951 and October 1952.

PLANS FOR 1953

Continue work on...

1. Range problem analysis.
2. 1950 range plant-control studies.
3. Use of chemical herbicides for killing oak-wilt infested trees (in cooperation with the Division of Forest Pathology).

Begin work on...

1. Key for Ozark range plants.
2. Study of forage growth and utilization on glade-type range.

Report on...

1. Responses of herbaceous vegetation to overhead release (in cooperation with the Missouri Wildlife Research Unit and the Missouri Conservation Commission).
2. Reseeding study (in cooperation with the Mark Twain National Forest).
3. Eastern redcedar burning study.
4. Chemical control of woody plants (in cooperation with the Forestry Department and Weed Control Committee of the University of Missouri).

FOREST INFLUENCES

FLOOD-CONTROL SURVEYS

Damages suffered from the 1952 floods reached new highs in many areas, yet appropriations for watershed flood-control surveys in 1952 were cut drastically for the second successive year. Becker and Morey participated in a number of flood-control surveys for which the Soil Conservation Service has primary responsibility. They conducted field examinations of the forested portions of the watersheds and prepared the reports. Morey also took part in the Federal Interagency River Basin Committee (FIARBC) planning activities in the Arkansas-Red-White and Missouri River drainage basins. The work accomplished included:

1. Survey reports for the Cuyahoga River watershed in Ohio and the Licking River watershed in Kentucky were completed.
2. Detailed surveys of the following watersheds were made:
 - David's Creek (Iowa)
 - East Branch of South Fork of Blackwater River (Missouri)
 - East Willow Creek (Minnesota)
 - Honey Creek (Iowa)
 - Lost Creek (Missouri)
 - Old Tom Creek (Illinois)
 - South Fork of the Crow River (Minnesota)
 - Switzer Creek (Kansas)
3. Reports for the Cuyahoga River, East Willow Creek, Kentucky River (Kentucky), Licking River, Lost Creek, Money Creek, Old Tom Creek, and South Fork of the Crow River watersheds were reviewed.
4. The Kentucky River watershed survey report was revised in response to comments of reviewers.
5. Field work was completed on the Nishnabotna River watershed in southwestern Iowa and northwestern Missouri.
6. Comprehensive agricultural programs for the Arkansas-Red-White and Missouri basins were developed with the Station's help.

Morey was transferred to the Washington Office Section of Flood-Control Surveys and this activity was closed out at the Station on December 5.

When work on a project is discontinued it is appropriate to take stock of what has been done and what has been left undone. The Central States Station began its flood-control studies by helping investigate watershed conditions that contributed to the 1927 flood in the Mississippi and Ohio River Valleys. Flood-control

surveys began shortly after the Flood-Control Act of 1936 was passed and continued with but one interruption until 1952. Work was halted from June 1941 to March 1948 because of the national defense program. The status of flood-control surveys in which this Station has participated is given below. Except where noted, primary responsibility for all surveys listed is assigned to the Soil Conservation Service. This Station participated by investigating watershed conditions on the forest land and developing the flood-control program for this land.

During its less than 10 years of actual flood-control survey work, the Central States Station took part in the surveys of 44 watersheds. The reports for nearly half of these are still being revised or reviewed. The streams involved are:

Blackwater River (Missouri)	Lost Creek (Missouri)
Crow River (Minnesota)	Money Creek (Illinois)
Cuyahoga River (Ohio)	Old Tom Creek (Illinois)
David's Creek (Iowa)	Salt River (Kentucky)
East Willow Creek (Minnesota)	White River (Indiana)
Honey Creek (Iowa)	Upper Mississippi River:
Indian Creek (Iowa)	Galena River (Ill. and Wis.)
Kentucky River (Kentucky)	Root River (Minnesota)
Licking River and Ohio River	Sagamon River (Illinois)
tributaries (Kentucky)	Whitewater River (Minnesota)

Eight flood-control survey reports for this region have been presented to Congress:

Grand River (Iowa and Missouri)	Scioto River (Ohio)
Green River (Ky. and Tenn.)	Sny River (Illinois)
(This was the first postwar flood-control survey report to be printed as a Congressional document.)	Little Sioux River (Iowa)
Missouri River (Iowa and Missouri)	(This report was approved and later developed into the only action program in the Station's territory.)
Osage River (Kansas and Missouri)	

Surveys of the Muskingum River in Ohio and the St. Francis River in Missouri disclosed that at the time it would be unprofitable to undertake further remedial programs. Since then, however, conditions have changed on the Muskingum and Congress in 1949 recommended that the watershed be resurveyed.

Preliminary examinations of three other rivers in Iowa and Missouri--North and Middle Fabins, the Turkey, and the Weldon--indicated that watershed treatment would not help the situation enough to make the work profitable.

Preliminary examinations were made of 10 other watersheds but no further action has been taken. A report on the Nishnabotna River in Iowa, Missouri, and Nebraska is being prepared.

The comprehensive plan for agriculture in the Missouri River basin has been developed and published as House Document 373 (81st Congress, 2nd Session). This has not yet been integrated with the so-called Pick-Sloan plan, prepared by the Army Engineers and the Bureau of Reclamation. A major objective of the Missouri River Interagency Committee is to develop a single integrated plan for the basin. Supplemental reports containing comprehensive agricultural plans are being prepared for a number of small watersheds in the Missouri basin. The first such report, which included the comprehensive program for the Osage River watershed, was published in 1952 as House Document 530 (82nd Congress, 2nd Session). A similar plan is being developed for the Arkansas-Red-White River basin.

Flood-control surveys show that 95 percent of the upland forest lands in the watersheds investigated have recently been or are potential sources of floods. These conditions are caused by (1) overgrazing; (2) excessive cutting; (3) fire, and (4) careless logging. Removing too much of the protective vegetation and litter, depleting the humus, and compacting the soil all decrease the ability of the soil to absorb and store water. This accelerates soil erosion.

How can we manage forest lands for the production of valuable timber and at the same time conserve the waters that fall upon those lands for domestic and industrial use? How can soil erosion resulting from logging operations best be minimized? What is the effect on humus accumulation of heavy cutting, of moderate or light cutting? What happens to soil moisture levels, soil structure, and infiltration capacities under different methods and intensities of timber harvest? It is the task of forest influences research to answer these questions. In the Central States this work has just begun.

FOREST INFLUENCES RESEARCH

Forest influences studies were severely set back in the past year by the untimely death of staff member Richard N. Gaiser, who was in charge of this work at the Buckeye Research Center.

Dr. Gaiser was to have presented a paper at the annual meeting of the Forest Soils Section of the Soil Science Society in November. The paper, "Readily Available Water in Forest Soils," summarized a year of weekly soil moisture measurements made in forest soils located on ridge, middle slope, and lower slope sites. The data indicate that available water is almost completely utilized

during the growing season. On moist sites probably more than 60 percent of the annual precipitation is transpired and evaporated from all surfaces of the forest and soil. The detailed results of this study were published in October 1952 in the Society's Meeting Proceedings.

Late in 1952 arrangements were made with the Department of Forestry, University of Missouri, through a cooperative aid agreement, to study the relationships of soil and second-growth shortleaf pine management. The broad objectives of this study are: (1) To describe in detail the soils on the various shortleaf pine plots so that changes in the soil brought about by different treatments of the stands can be detected and measured; (2) to determine the effects of different stand densities, with and without a hardwood understory, on the soil moisture available to the trees, and (3) to find out how tree growth is affected by changes in soil and soil moisture.

PLANS FOR 1953

Willard H. Carmean will take over the forest influences work at the Buckeye Research Center in July 1953. He will complete studies that Dr. Gaiser had underway and will plan influence studies for the Vinton Furnace Experimental Forest. Many of the management studies tentatively planned for the forest will provide opportunities for collecting influence data. Several minor watersheds within the forest will provide sites for runoff studies. Dr. Carmean will also complete the forest influence problem area analysis begun by Dr. Gaiser before his death.

FOREST UTILIZATION SERVICE

The Forest Utilization Service is a field arm of the U. S. Forest Products Laboratory at Madison, Wisconsin. The unit does a minimum of direct research, but rather evaluates the problems of the wood-using industries and presents these problems to the Forest Products Laboratory or other research institutions. The unit also brings to these industries the findings of forest utilization research for application in commercial operations. In addition it helps the Station's branches and experimental forests on utilization problems associated with their research activities.

The over-all objective of the Forest Utilization Service (F.U.S.) is to help industry find better ways of utilizing our forest resources.

The Central States is one of the most important wood-using areas. Of the nearly 14 billion board-feet of lumber reported as used in the 1948 "U. S. Census of Wood Used in Manufacture," Illinois, Ohio, Indiana, Missouri, Kentucky, and Iowa consumed nearly one-fifth. Because of this concentration, requests for assistance from industry received by this Station's F.U.S. unit run into the hundreds each year. While many requests can be handled by office conferences, correspondence, or passed on to specialists at the Forest Products Laboratory or other qualified institutions, more and more require on-the-ground assistance. With only one man to do the work last year, all requests for help could not be met. However, specific services were extended to 35 industries and organizations on a wide range of wood utilization problems. Among the more important industries and organizations receiving such direct assistance last year were: American Pulpwood Association, Appalachian Hardwood Manufacturers Association, Ohio Department of Natural Resources, Ohio State University, Muskingum Watershed Conservancy District, Pennsylvania Railroad, Baldwin Piano Company, Monsanto Chemical Company, Chester B. Stem Veneer Company, Chess and Wymond Cooperage Company, Independent Stave Company, and the Stone Container Corporation. In some urgent cases, arrangements were made to have personnel from the Forest Products Laboratory give direct field assistance on specialized problems.

Our F.U.S. unit keeps in close touch with the industry in order to keep abreast of wood-using problems and bring to these companies the results of forest products research. Because of the increasing demand for on-the-ground consulting service, it has become necessary to work mostly through the wood utilization trade associations. During the past year much work was carried out through such associations, and through technical, scientific, and research societies, state and industrial associations, state and federal forestry agencies, agricultural colleges, and state

agricultural extension services. More than half the time of the F.U.S. specialist was spent on timber harvesting and conversion, wood container, and wood seasoning projects.

During the first quarter of 1952, Day was at the Forest Products Laboratory making a special study of the pallet industry in the United States, summarizing the results of the extensive research of the Forest Products Laboratory in this field, and preparing a report.

TIMBER HARVESTING

During the past year the F.U.S. unit continued its program of assisting small rural industries. The annual forestry, logging, and sawmilling demonstration, sponsored by F.U.S. in cooperation with the state extension foresters, has been very effective in bringing to the small sawmill operator, the local wood-using industries, the farm woodland owners, and other timber producers, the newest developments in these fields. The 1952 demonstration was held at the Southeastern Substation of the Ohio Agricultural Experiment Station. More than fifty manufacturers, distributors, and dealers in the field of forestry, logging, and sawmilling equipment, exhibited and demonstrated their products. Other exhibits and demonstrations were carried out by the Ohio Division of Forestry, the Ohio Agricultural Experiment Station, the Soil Conservation Service, and the U. S. Forest Products Laboratory. Approximately 2,500 persons attended the two-day show.

We arranged for and accompanied the small sawmill specialist of the Forest Products Laboratory on inspection trips to some 12 small sawmills in the region. Recommendations for improving plant layout, equipment, and manufacturing methods at these mills in most instances have been or will be adopted.

WOOD SEASONING

For several years there has been a definite need for small-capacity dry kilns suitable for sawmills and small secondary plants. During 1952 the Standard Dry Kiln Company of Indianapolis announced a small packaged dry kiln which should partially fill this need. Unfortunately, it depends on steam which still leaves unsolved the problem of the small rural industries that cannot afford a steam plant.

Work at the Forest Products Laboratory in seasoning small quantities of lumber with agricultural crop driers is of special interest and promise in this region. The Peirson-Moore Company of Lexington, Kentucky, manufacturer of crop driers, has been interested

in lumber drying as a side line and has sold a number of conventional kilns built around their heating units. This company cooperated with the Forest Products Laboratory in a demonstration of the crop drier kiln at our recent logging show in Ohio. The demonstration drew so much attention that the company is exploring the kiln's commercial possibilities.

Air and kiln drying problems at six plants were reviewed with company officials. The F.U.S. unit also participated in a 3-day seminar on kiln drying sponsored by the Ohio Forestry Association and attended by some 35 kiln operators or management representatives from central Ohio.

OTHER ACTIVITIES

F.U.S. in cooperation with the Division of Forest Economics assembled information on forest resources and industrial opportunities within the region for a number of forest industries, trade associations, chambers of commerce, and other organizations interested in wood and manufacturing markets. One thing these organizations were especially interested in was the possibility of using woods and mill waste in manufacturing hardboard, woodpulp, molasses, and metalurgical chips. Investigation indicated that there is a large volume of such material suitable and available for these uses. Paper and box manufacturers in Ohio and Indiana that use straw for their raw material are becoming increasingly interested in switching to woodpulp. This is not only because semi-chemical woodpulp has been found to be superior to straw but also because production costs may be lowered by using woods and mill waste. Tests made at the Forest Products Laboratory with Central States hardwoods indicate a satisfactory corrugated paper can be manufactured from sawmill slabs with a bark content of as much as 30 percent.

PLANS FOR 1953

The major tasks for the coming year will be much the same as last. The F.U.S. unit will continue cooperating with the wood-using industries in developing and putting into practice new utilization methods. Technical assistance will be given to the new utilization pilot plant at the Carbondale Research Center. A log grading training school and demonstration will be conducted. Will assist in carrying out a forestry, logging, and sawmilling demonstration in Missouri. As much time as possible will be given to such new projects as using wood waste for mulches, livestock bedding, and soil conditioners; training farm foresters in small sawmill practices; increased use of farm-grown timber in farm construction; and farm woodland harvesting equipment and methods.

PERSONNEL

CENTRAL STATES FOREST EXPERIMENT STATION

(As of December 31, 1952)

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PHILIP A. BRIEGLEB, Director; Mary L. Posey, Secretary;
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Field Inventory -- Kenneth L. Quigley, Roy A. Whitmore, Jr.,
James D. Burton

Statistical Procedures -- Chester E. Jensen, Margaret K.
Peirsol

Computing and Compilation -- Lake F. Compton

Forest Industry Analysis -- James T. Morgan

Forest Resource Analysis -- O. Keith Hutchison

Farm Woodland Marketing Studies -- Kenneth L. Quigley

FOREST UTILIZATION SERVICE

RALPH K. DAY, In Charge; Virginia D. Simone, Stenographer

* LWOP to further education

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Sinkin Experimental Forest, c/o U. S. Forest Service, Salem, Missouri

Nelson F. Rogers, John S. Crosby, Wayne M. Harrison

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FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

